

Population Viability Analysis

Part A

To make political decisions about the extent and type of forestry in a region it is important to understand the consequences of those decisions. One tool for assessing the impact of forestry on the ecosystem is population viability analysis (PVA). This is a tool for predicting the probability that a species will become extinct in a particular region over a specific period. It has been successfully used in the United States to provide input into resource exploitation decisions and assist wildlife managers and there is now enormous potential for using population viability to assist wildlife management in Australia's forests. A species becomes extinct when the last individual dies. This observation is a useful starting point for any discussion of extinction as it highlights the role of luck and chance in the extinction process. To make a prediction about extinction we need to understand the processes that can contribute to it and these fall into four broad categories which are discussed below.

Part B

A) Early attempts to predict population viability were based on demographic uncertainty whether an individual survives from one year to the next will largely be a matter of chance. Some pairs may produce several young in a single year while others may produce none in that same year. Small populations will fluctuate enormously because of the random nature of birth and death and these chance fluctuations can cause species extinctions even if, on average, the population size should increase. Taking only this uncertainty of ability to reproduce into account, extinction is unlikely if the number of individuals in a population is above about 50 and the population is growing.

B) Small populations cannot avoid a certain amount of inbreeding. This is particularly true if there is a very small number of one sex. For example, if there are only 20 individuals of a species and only one is a male, all future individuals in the species must be descended from that one male. For most animal species such individuals are less likely to survive and reproduce. Inbreeding increases the chance of extinction.

C) Variation within a species is the raw material upon which natural selection acts. Without genetic variability, a species lacks the capacity to evolve and cannot adapt to changes in its environment or to new predators and new diseases. The loss of genetic diversity associated with reductions in population size will contribute to the likelihood of extinction.

D) Recent research has shown that other factors need to be considered. Australia's environment fluctuates enormously from year to year. These fluctuations add yet another degree of uncertainty to the survival of many species. Catastrophes such as fire, flood, drought or epidemic may reduce population sizes to a small fraction of their average level. When allowance is made for these two additional elements of uncertainty the population size necessary to be confident of persistence for a few hundred years may increase to several thousand.

Part C

Besides these processes, we need to bear in mind the distribution of a population. A species that occurs in five isolated places each containing 20 individuals will not have the same probability of extinction as a species with a single population of 100 individuals in a single locality. Where logging occurs (that is, the cutting down of forests for timber) forest-dependent creatures in that area will be forced to leave.

Ground-dwelling herbivores may return within a decade. However, arboreal marsupials (that is animals which live in trees) may not recover to pre-logging densities for over a century. As more forests are logged, animal population sizes will be reduced further. Regardless of the theory or model that we choose, a reduction in population size decreases the genetic diversity of a population and increases the probability of extinction because of any or all of the processes listed above. It is therefore, a scientific fact that increasing the area that is logged in any region will increase the probability that forest-dependent animals will become extinct.

Questions 28-31:

Do the following statements agree with the views of the writer in *Part A* of Reading Passage 1? In boxes 28-31 on your answer sheet write:

YES if the statement agrees with the writer

NO if the statement contradicts the writer

NOT GIVEN if it is impossible to say what the writer thinks about this

Example	Answer
A link exists between the consequences of decisions and the decision making process itself.	YES

- 28. Scientists are interested in the effect of forestry on native animals.
- 29. PVA has been used in Australia for many years.
- 30. A species is said to be extinct when only one individual exists.
- 31. Extinction is a naturally occurring phenomenon.

Questions 32-35:

These questions are based on Part B of Reading Passage 1. In paragraphs **A** to **D** the author describes four processes which may contribute to the extinction of a species. Match the list of processes (**i-vi**) to the paragraphs. Write the appropriate number (**i-vi**) in boxes **32-35** on your answer sheet.

NB. There are more processes than paragraphs so you will not use all of them.

- 32. Paragraph A **Processes**
 - i Loss of ability to adapt
- 33. Paragraph B ii Natural disasters
 - iii An imbalance of the sexes
- 34. Paragraph C iv Human disasters
 - v Evolution
- 35. Paragraph D vi The haphazard nature of reproduction

Questions 36-38:

Based on your reading of Part C, complete the sentences below with words taken from the passage.

Use **NO MORE THAN THREE WORDS** for each answer. Write your answers in boxes 36-38 on your answer sheet.

While the population of a species may be on the increase, there is always a chance that small isolated groups..... (36) Survival of a species depends on a balance between the size of a population and its (37) The likelihood that animals which live in forests will become extinct is increased when (38)

Question 39:

Choose the appropriate letter **A-D** and write it in box 39 on your answer sheet.

39. An alternative heading for the passage could be:

- A. The protection of native flora and fauna
- B. Influential factors in assessing survival probability
- C. An economic rationale for the logging of forests
- D. Preventive measures for the extinction of a species

Part 1

From a number of recent studies, it has become clear that blind people can appreciate the use of outlines and perspectives to describe the arrangement of objects and other surfaces in



Fig. 1

space.

But pictures are more than literal representations. This fact was

drawn to my attention dramatically when a blind woman in one of my investigations decided on her own initiative to draw a wheel as it was spinning. To show this motion, she traced a curve inside the circle (Fig. 1). I was taken aback, lines of motion, such as the one she used, are a very recent invention in the history of illustration. Indeed, as art scholar David Kunzle notes, Wilhelm Busch, a trend-setting nineteenth-century cartoonist, used virtually no motion lines in his popular figure until about 1877. When I asked several other blind study subjects to draw a spinning wheel, one particularly clever rendition appeared repeatedly: several subjects showed the wheel's spokes as curves lines. When asked about these curves, they all described them as metaphorical ways of suggesting motion. Majority rule would argue that this device somehow indicated motion very well. But was it a better indicator than, say, broken or wavy lines or any other kind of line, for that matter? The answer was not clear. So I decided to test whether various lines of motion were apt ways of showing movement or if they were merely idiosyncratic marks. Moreover, I wanted to discover whether there were differences in how the blind and the sighted interpreted lines of motion.

To search out these answers, I created raised-line drawings of five different wheels, depicting spokes with lines that curved, bent, waved, dashed and extended beyond the perimeters of the wheel. I then asked eighteen blind volunteers to feel the wheels and assign one of the following motions to each wheel: wobbling, spinning fast, spinning steadily, jerking or braking. My control group consisted of eighteen sighted undergraduates from the University of Toronto.

All but one of the blind subjects assigned distinctive motions to each wheel. Most guessed that the curved spokes indicated that the wheel was spinning steadily; the wavy spokes, they thought, suggested that the wheel was wobbling, and the bent spokes were taken as a sign that the wheel was jerking. Subjects assumed that spokes extending beyond the wheel's perimeter signified that the wheel had its brakes on and that dashed spokes indicated the wheel was spinning quickly.

In addition, the favoured description for the sighted was favoured description for the blind in every instance. What is more, the consensus among the sighted was barely higher than that among the blind. Because motion devices are unfamiliar to the blind, the task I gave them involved some problem solving. Evidently, however, the blind not only figured out the meaning for each of the motion, but as a group they generally came up with the same meaning at least as frequently as did sighted subjects.

Part 2

We have found that the blind understand other kinds of visual metaphors as well. One blind woman drew a picture of a child inside a heart-choosing that symbol, she said, to show that love surrounded the child. With Chang Hong Liu, a doctoral student from china, I have begun exploring how well blind people understand the symbolism behind shapes such as hearts that do not directly represent their meaning. We gave a list of twenty pairs of words to sighted subjects and asked them to pick from each pair the term that best related to a circle and the term that best related to assure. For example, we asked: what goes with soft? A circle or a square? Which shape goes with hard?

Words associated among	Agreement subjects(%)
with circle/square	
SOFT-HARD	100
MOTHER-FATHER	94
HAPPY-SAD	94
GOOD-EVIL	89
LOVE-HATE	89
ALIVE-DEAD	87
BRIGHT-DARK	87
LIGHT-HEAVY	85
WARM-COLD	81
SUMMER-WINTER	81
WEAK-STRONG	79
FAST-SLOW	79
CAT-DOG	74
SPRING-FALL	74
QUIET-LOUD	62
WALKING-STANDING	62
ODD-EVEN	57
FAR-NEAR	53

PLANT-ANIMAL	53
DEEP-SHALLOW	51

Fig. 2- Subjects were asked which word in each pair fits with a circle and which with a square. These percentages show the level of consensus among sighted subjects.

All our subjects deemed the circle soft and the square hard. A full 94% ascribed happy to the circle, instead of sad. But other pairs revealed less agreement: 79% matched fast to slow and weak to strong, respectively. And only 51% linked deep to circle and shallow to square. (see Fig. 2) When we tested four totally blind volunteers using the same list, we found that their choices closely resembled those made by the sighted subjects. One man, who had been blind since birth, scored extremely well. He made only one match differing from the consensus, assigning 'far' to square and 'near' to circle. In fact, only a small majority of sighted subjects, 53%, had paired far and near to the opposite partners. Thus we concluded that the blind interprets abstract shapes as sighted people do.

Questions :

Choose the correct letter, **A, B, C** or **D**.

Write your answers in boxes **27 –29** on your answer sheet.

27 In the first paragraph, the writer makes the point that blind people

- A. may be interested in studying art.
- B. can draw outlines of different objects and surfaces.
- C. can recognise conventions such as perspective.
- D. can draw accurately.

28 The writer was surprised because the blind woman

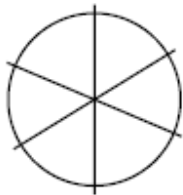
- A. drew a circle on her own initiative.
- B. did not understand what a wheel looked like.
- C. included a symbol representing movement.
- D. was the first person to use lines of motion.

29 From the experiment described in Part 1, the writer found that the blind subjects

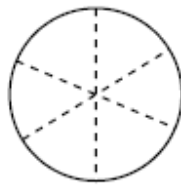
- A. had good understanding of symbols representing movement.
- B. could control the movement of wheels very accurately.
- C. worked together well as a group in solving problems.
- D. got better results than the sighted undergraduates.

Questions 30–32

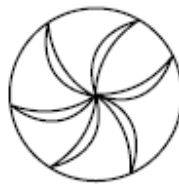
Look at the following diagrams (Questions 30–32), and the list of types of movement below. Match each diagram to the type of movement **A–E** generally assigned to it in the experiment. Choose the correct letter **A–E** and write them in boxes **30–32** on your answer sheet.



30



31



32

- A steady spinning
- B jerky movement
- C rapid spinning
- D wobbling movement
- E use of brakes

Questions 33–39

Complete the summary below using words from the box. Write your answers in boxes 33–39 on your answer sheet. **NB** You may use any word more than once.

In the experiment described in Part 2, a set of word **33**..... was used to investigate whether blind and sighted people perceived the symbolism in abstract **34**..... in the same way. Subjects were asked which word fitted best with a circle and which with a square. From the **35**..... volunteers, everyone thought a circle fitted 'soft' while a square fitted 'hard'. However, only 51% of the **36**..... volunteers assigned a circle to **37**..... . When the test was later repeated with **38**..... volunteers, it was found that they made **39**..... choices.

associations	blind	deep	hard	hundred	identical	pairs
shapes	sighted	similar	shallow	soft	words	

Question 40

Choose the correct letter **A**, **B**, **C** or **D**. Write your answer in box 40 on your answer sheet.

Which of the following statements best summarises the writer's general conclusion?

- A The blind represent some aspects of reality differently from sighted people.
- B The blind comprehend visual metaphors in similar ways to sighted people.
- C The blind may create unusual and effective symbols to represent reality.
- D The blind may be successful artists if given the right training.

Zoo Conservation Programmes

One of London Zoo's recent advertisements caused me some irritation, so patently did it distort reality. Headlined "Without zoos, you might as well tell these animals to get stuffed", it was bordered with illustrations of several endangered species and went on to extol the myth that without zoos like London Zoo these animals "will almost certainly disappear forever". With the zoo world's rather mediocre record on conservation, one might be forgiven for being slightly sceptical about such an advertisement.

Zoos were originally created as places of entertainment, and their suggested involvement with conservation didn't seriously arise until about 30 years ago, when the Zoological Society of London held the first formal international meeting on the subject. Eight years later, a series of world conferences took place, entitled "The Breeding of Endangered Species", and from this point onwards conservation became the zoo community's buzzword. This commitment has now been clearly defined in The World Zoo Conservation Strategy (WZCS, September 1993), which although an important and welcome document does seem to be based on an unrealistic optimism about the nature of the zoo industry.

The WZCS estimates that there are about 10,000 zoos in the world, of which around 1,000 represent a core of quality collections capable of participating in coordinated conservation programmes. This is probably the document's first failing, as I believe that 10,000 is a serious underestimate of the total number of places masquerading as zoological establishments. Of course, it is difficult to get accurate data but, to put the issue into perspective, I have found that, in a year of working in Eastern Europe, I discover fresh zoos on almost a weekly basis.

The second flaw in the reasoning of the WZCS document is the naive faith it places in its 1,000 core zoos. One would assume that the calibre of these institutions would have been carefully examined, but it appears that the criterion for inclusion on this select list might merely be that the zoo is a member of a zoo federation or association. This might be a good starting point, working on the premise that members must meet certain standards, but again the facts don't support the theory. The greatly respected American Association of Zoological Parks and Aquariums (AAZPA) has had extremely dubious members, and in the UK the Federation of Zoological Gardens of Great Britain and Ireland has

Occasionally had members that have been roundly censured in the national press. These include Robin Hill Adventure Park on the Isle of Wight, which many considered the most notorious collection of animals in the country. This establishment, which for years was protected by the Isle's local council (which viewed it as a tourist amenity), was finally closed down following a damning report by a veterinary inspector appointed under the terms of the Zoo Licensing Act 1981. As it was always a collection of dubious repute, one is obliged to reflect upon the standards that the Zoo Federation sets when granting membership. The situation is even worse in developing countries where little money is available for redevelopment and it is

hard to see a way of incorporating collections into the overall scheme of the WZCS.

Even assuming that the WZCS's 1,000 core zoos are all of a high standard complete with scientific staff and research facilities, trained and dedicated keepers, accommodation that permits normal or natural behaviour, and a policy of co-operating fully with one another what might be the potential for conservation? Colin Tudge, author of *Last Animals at the Zoo* (Oxford University Press, 1992), argues that "if the world's zoos worked together in co-operative breeding programmes, then even without further expansion they could save around 2,000 species of endangered land vertebrates". This seems an extremely optimistic proposition from a man who must be aware of the failings and weaknesses of the zoo industry the man who, when a member of the council of London Zoo, had to persuade the zoo to devote more of its activities to conservation. Moreover, where are the facts to support such optimism?

Today approximately 16 species might be said to have been "saved" by captive breeding programmes, although a number of these can hardly be looked upon as resounding successes. Beyond that, about a further 20 species are being seriously considered for zoo conservation programmes. Given that the international conference at London Zoo was held 30 years ago, this is pretty slow progress, and a long way off Tudge's target of 2,000.

Do the following statements agree with the views of the writer in Reading Passage 3? In boxes **16-22** write :

Y if the statement agrees with the writer

N if the statement contradicts the writer

NG if it is impossible to say what the writer thinks about this

16. London Zoo's advertisements are dishonest.
17. Zoos made an insignificant contribution to conservation up until 30 years ago.
18. The WZCS document is not known in Eastern Europe.
19. Zoos in the WZCS select list were carefully inspected.
20. No-one knew how the animals were being treated at Robin Hill Adventure Park.
21. Colin Tudge was dissatisfied with the treatment of animals at London Zoo.
22. The number of successful zoo conservation programmes is unsatisfactory.

Questions 23-25

Choose the appropriate letters A-D and write them in boxes 23-25 on your answer sheet.

23 What were the objectives of the WZCS document?

- A. to improve the calibre of zoos worldwide
- B. to identify zoos suitable for conservation practice

- C. to provide funds for zoos in underdeveloped countries
- D. to list the endangered species of the world

24 Why does the writer refer to Robin Hill Adventure Park?

- A. to support the Isle of Wight local council
- B. to criticise the 1981 Zoo Licensing Act
- C. to illustrate a weakness in the WZCS document
- D. to exemplify the standards in AAZPA zoos

25 What word best describes the writer's response to Colin Tudges' prediction on captive breeding programmes?

- A. disbelieving
- B. impartial
- C. prejudiced
- D. accepting

Questions 26-28

The writer mentions a number of factors which lead him to doubt the value of the WZCS document. Which THREE of the following factors are mentioned? Write your answers (A-F) in boxes 26-28 on your answer sheet.

List of Factors:

- A. the number of unregistered zoos in the world
- B. the lack of money in developing countries
- C. the actions of the Isle of Wight local council
- D. the failure of the WZCS to examine the standards of the "core zoos"
- E. the unrealistic aim of the WZCS in view of the number of species "saved" to date
- F. the policies of WZCS zoo managers

A Workaholic Economy

For the first century or so of the industrial revolution, increased productivity led to decreases in working hours. Employees who had been putting in 12-hour days, six days a week, found their time on the job shrinking to 10 hours daily, then finally to eight hours, five days a week. Only a generation ago social planners worried about what people would do with all this new-found free time. In the US, at least it seems they need not have bothered.

Although the output per hour of work has more than doubled since 1945, leisure seems reserved largely for the unemployed and underemployed. Those who work full-time spend as much time on the job as they did at the end of World War II. In fact, working hours have increased noticeably since 1970 — perhaps because real wages have stagnated since that year. Bookstores now abound with manuals describing how to manage time and cope with stress.

There are several reasons for lost leisure. Since 1979, companies have responded to improvements in the business climate by having employees work overtime rather than by hiring extra personnel, says economist Juliet B. Schor of Harvard University. Indeed, the current economic recovery has gained a certain amount of notoriety for its “jobless” nature: increased production has been almost entirely decoupled from employment. Some firms are even downsizing as their profits climb. “All things being equal, we'd be better off spreading around the work,” observes labour economist Ronald G. Ehrenberg of Cornell University.

Yet a host of factors pushes employers to hire fewer workers for more hours and at the same time compels workers to spend more time on the job. Most of those incentives involve what Ehrenberg calls the structure of compensation: quirks in the way salaries and benefits are organised that make it more profitable to ask 40 employees to labour an extra hour each than to hire one more worker to do the same 40-hour job.

Professional and managerial employees supply the most obvious lesson along these lines. Once people are on salary, their cost to a firm is the same whether they spend 35 hours a week in the office or 70. Diminishing returns may eventually set in as overworked employees lose efficiency or leave for more arable pastures. But in the short run, the employer's incentive is clear. Even hourly employees receive benefits - such as pension contributions and medical insurance - that are not tied to the number of hours they work. Therefore, it is more profitable for employers to work their existing employees harder.

For all that employees complain about long hours, they too have reasons not to trade money for leisure. “People who work reduced hours pay a huge penalty in career terms,” Schor maintains. “It's taken as a negative signal' about their commitment to the firm.’ [Lotte] Bailyn [of Massachusetts Institute of Technology] adds that many corporate managers find it difficult to measure the contribution of their

underlings to a firm's well-being, so they use the number of hours worked as a proxy for output. "Employees know this," she says, and they adjust their behaviour accordingly.

"Although the image of the good worker is the one whose life belongs to the company," Bailyn says, "it doesn't fit the facts." She cites both quantitative and qualitative studies that show increased productivity for part-time workers: they make better use of the time they have and they are less likely to succumb to fatigue in stressful jobs. Companies that employ more workers for less time also gain from the resulting redundancy, she asserts. "The extra people can cover the contingencies that you know are going to happen, such as when crises take people away from the workplace." Positive experiences with reduced hours have begun to change the more-is-better culture at some companies, Schor reports.

Larger firms, in particular, appear to be more willing to experiment with flexible working arrangements...

It may take even more than changes in the financial and cultural structures of employment for workers successfully to trade increased productivity and money for leisure time, Schor contends. She says the U.S. market for goods has become skewed by the assumption of full-time, two-career households. Automobile makers no longer manufacture cheap models, and developers do not build the tiny bungalows that served the first postwar generation of home buyers. Not even the humblest household object is made without a microprocessor. As Schor notes, the situation is a curious inversion of the "appropriate technology" vision that designers have had for developing countries: U.S. goods are appropriate only for high incomes and long hours. --- **Paul Walluh.**

Questions 27-32

Do the following statements agree with the views of the writer in reading passage 4? In boxes 27-32 on your answer sheet write:

YES if the statement agrees with the writer

NO if the statement contradicts the writer

NOT GIVEN if it is impossible to say what the writer thinks about this

Example	Answer
During the industrial revolution, people worked harder	NOT GIVEN

- 27 Today, employees are facing a reduction in working hours.
- 28 Social planners have been consulted about US employment figures.
- 29 Salaries have not risen significantly since the 1970s.
- 30 The economic recovery created more jobs.
- 31 Bailyn's research shows that part-time employees work more efficiently.
- 32 Increased leisure time would benefit two-career households.

Questions 33-34

Choose the appropriate letters **A-D** and write them in boxes **33** and **34** on your answer sheet.

33 Bailyn argues that it is better for a company to employ more workers because

- A. it is easy to make excess staff redundant.
- B. crises occur if you are under-staffed.
- C. people are available to substitute for absent staff.
- D. they can project a positive image at work.

34 Schor thinks it will be difficult for workers in the US to reduce their working hours because

- A. they would not be able to afford cars or homes.
- B. employers are offering high incomes for long hours.
- C. the future is dependent on technological advances.
- D. they do not wish to return to the humble post-war era.

Questions 35-38

The writer mentions a number of factors that have resulted, in employees working longer hours.

Which **FOUR** of the following factors are mentioned? Write your answers (**A-H**) in boxes **35-38** on your answer sheet.

List of Factors

- A Books are available to help employees cope with stress.
- B Extra work is offered to existing employees.
- C Increased production has led to joblessness.
- D Benefits and hours spent on the job are not linked.
- E Overworked employees require longer to do their work.
- F Longer hours indicate a greater commitment to the firm.
- G Managers estimate staff productivity in terms of hours worked.
- H Employees value a career more than a family.

A Remarkable Beetle

Some of the most remarkable beetles are the dung beetles, which spend almost their whole lives eating and breeding in dung.



More than 4,000 species of these remarkable creatures have evolved and adapted to the world's different climates and the dung of its many animals. Australia's native dung beetles are scrub and woodland dwellers, specialising in coarse marsupial droppings and avoiding the soft cattle dung in which bush flies and buffalo flies breed.

In the early 1960s George Bornemissza, then a scientist at the Australian Government's premier research organisation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), suggested that dung beetles should be introduced to Australia to control dung-breeding flies. Between 1968 and 1982, the CSIRO imported insects from about 50 different species of dung beetle, from Asia, Europe and Africa, aiming to match them to different climatic zones in Australia. Of the 26 species that are known to have become successfully integrated into the local environment, only one, an African species released in northern Australia, has reached its natural boundary.

Introducing dung beetles into a pasture is a simple process: approximately 1,500 beetles are released; a handful at a time, into fresh cow pats in the cow pasture. The beetles immediately disappear beneath the pats digging and tunnelling and, if they successfully adapt to their new environment, soon become a permanent, self-sustaining part of the local ecology. In time they multiply and within three or four years the benefits to the pasture are obvious.

Dung beetles work from the inside of the pat so they are sheltered from predators such as birds and foxes. Most species burrow into the soil and bury dung in tunnels directly underneath the pats, which are hollowed out from within. Some large species originating from France excavate tunnels to a depth of approximately 30 cm below the dung pat. These beetles make sausage-shaped brood chambers along the tunnels. The shallowest tunnels belong to a much smaller Spanish species that buries dung in chambers that hang like fruit from the branches of a pear tree. South African beetles dig narrow tunnels of approximately 20 cm below the surface of the pat. Some surface-dwelling beetles, including a South African species, cut perfectly-shaped balls from the pat, which are rolled away and attached to the bases of plants.

For maximum dung burial in spring, summer and autumn, farmers require a variety of species with overlapping periods of activity. In the cooler environments of the state of Victoria, the large French species (2.5 cms long) is matched with smaller (half this size), temperate-climate Spanish species. The former are slow to recover from the winter cold and produce only one or two generations of offspring from late spring until autumn. The latter, which multiplies rapidly in early spring, produce two to five generations annually. The South African ball-rolling species, being a subtropical beetle, prefers the climate of northern and coastal New South Wales where it commonly works with the South African tunnelling species. In warmer climates, many species are active for longer periods of the year.

Dung beetles were initially introduced in the late 1960s with a view to controlling buffalo flies by removing the dung within a day or two and so preventing flies from breeding. However, other benefits have become evident. Once the beetle larvae have finished pupation, the residue is a first-rate source of fertiliser. The tunnels abandoned by the beetles provide excellent aeration and water channels for root systems. In addition, when the new generation of beetles has left the nest the abandoned burrows are an attractive habitat for soil-enriching earthworms. The digested dung in these burrows is an excellent food supply for the earthworms, which decompose it further to provide essential soil nutrients. If it were not for the dung beetle, chemical fertiliser and dung would be washed by rain into streams and rivers before it could be absorbed into the hard earth, polluting water courses and causing blooms of blue-green algae. Without the beetles to dispose of the dung, cow pats would litter pastures making grass inedible to cattle and depriving the soil of sunlight. Australia's 30 million cattle each produce 10-12 cow pats a day. This amounts to 1.7 billion tonnes a year, enough to smother about 110,000 sq km of pasture, half the area of Victoria.

Dung beetles have become an integral part of the successful management of dairy farms in Australia over the past few decades. A number of species are available from the CSIRO or through a small number of private breeders, most of whom were entomologists with the CSIRO's dung beetle unit who have taken their specialised knowledge of the insect and opened small businesses in direct competition with their former employer.

Glossary

1. dung:- the droppings or excreta of animals
2. cow pats:- droppings of cows

Questions 1-5

Do the following statements reflect the claims of the writer in Reading Passage 6? In boxes 1-5 on your answer sheet write:

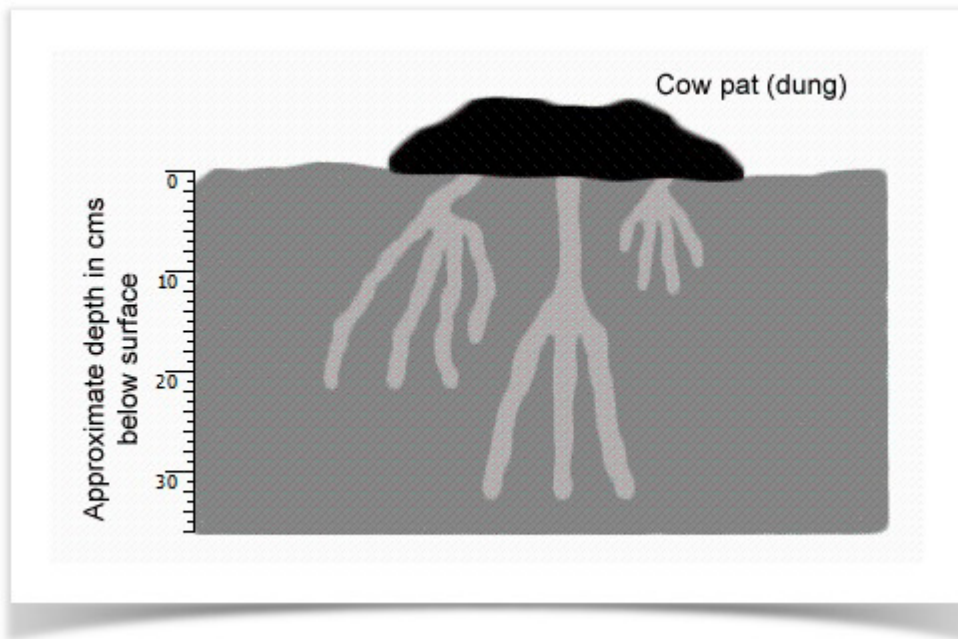
- YES if the statement reflects the claims of the writer
 NO if the statement contradicts the claims of the writer
 NOT GIVEN if it is impossible to say what the writer thinks about this

- 1 Bush flies are easier to control than buffalo flies.
- 2 Four thousand species of dung beetle were initially brought to Australia by the CSIRO.
- 3 Dung beetles were brought to Australia by the CSIRO over a fourteen-year period.
- 4 At least twenty-six of the introduced species have become established in Australia.
- 5 The dung beetles cause an immediate improvement to the quality of a cow pasture.

Questions 6-8

Label the tunnels on the diagram below. Choose your labels from the box below the diagram. Write your answers in boxes 6-8 on your answer sheet.

Write your answers in boxes 6-8 on your answer sheet.



Dung Beetle Types

French	Spanish
Mediterranean	South African
Australian native	South African ball roller.

Question 9-13

Complete the table below.

Choose **NO MORE THAN THREE WORDS OR A NUMBER** from Reading Passage 6 for each answer.

Write your answers in boxes 9—13 on your answer sheet.

Species	Size	Preferred Climate	Complementary species	Start of active period	Number of generations per year

French	2.5 cm	Cool	Spanish	Late spring	1-2
Spanish	1.25 cm	9		10	1
South African ball roller		12	13		

Alarming Rate of Loss of Tropical Rainforests

Adults and children are frequently confronted with statements about the alarming rate of loss of tropical



rainforests. For example, one graphic illustration to which children might readily relate is the estimate that rainforests are being destroyed at a rate equivalent to one thousand football fields every forty minutes – about the duration of a normal classroom period. In the face of the frequent and often vivid media coverage, it is likely that children will have formed ideas about rainforests – what and where they are, why they are important, what endangers them – independent of any formal tuition. It is also possible that some of these ideas will be mistaken. Many studies have shown that children harbour misconceptions about ‘pure’, curriculum science. These misconceptions do not remain isolated but become incorporated into a multifaceted, but organised, conceptual framework, making it and the component ideas, some of which are erroneous, more robust but also accessible to modification. These ideas may be developed by children absorbing ideas through the popular media. Sometimes this information may be erroneous. It seems schools may not be providing an opportunity for children to re-express their ideas and so have them tested and refined by teachers and their peers.

Despite the extensive coverage in the popular media of the destruction of rainforests, little formal information is available about children’s ideas in this area. The aim of the present study is to start to provide such information, to help teachers design their educational strategies to build upon correct ideas and to displace misconceptions and to plan programmes in environmental studies in their schools.

The study surveys children’s scientific knowledge and attitudes to rainforests. Secondary school children were asked to complete a questionnaire containing five open-form questions. The most frequent responses to the first question were descriptions which are self-evident from the term ‘rainforest’. Some children described them as damp, wet or hot. The second question concerned the geographical location of rainforests. The commonest responses were continents or countries: Africa (given by 43% of children), South America (30%), Brazil (25%). Some children also gave more general locations, such as being near the Equator.

Responses to question three concerned the importance of rainforests. The dominant idea, raised by 64% of the pupils, was that rainforests provide animals with habitats. Fewer students responded that rainforests provide plant habitats, and even fewer mentioned the indigenous populations of rainforests. More girls (70%) than boys (60%) raised the idea of the rainforest as animal habitats.

Similarly, but at a lower level, more girls (13%) than boys (5%) said that rainforests provided human habitats. These observations are generally consistent with our previous studies of pupils' views about the use and conservation of rainforests, in which girls were shown to be more sympathetic to animals and expressed views which seem to place an intrinsic value on non-human animal life.

The fourth question concerned the causes of the destruction of rainforests. Perhaps encouragingly, more than half of the pupils (59%) identified that it is human activities which are destroying rainforests, some personalising the responsibility by the use of terms such as 'we are'. About 18% of the pupils referred specifically to logging activity.

One misconception, expressed by some 10% of the pupils, was that acid rain is responsible for rainforest destruction; a similar proportion said that pollution is destroying rainforests. Here, children are confusing rainforest destruction with damage to the forests of Western Europe by these factors. While two-fifths of the students provided the information that the rainforests provide oxygen, in some cases this response also embraced the misconception that rainforest destruction would reduce atmospheric oxygen, making the atmosphere incompatible with human life on Earth.

In answer to the final question about the importance of rainforest conservation, the majority of children simply said that we need rainforests to survive. Only a few of the pupils (6%) mentioned that rainforest destruction may contribute to global warming. This is surprising considering the high level of media coverage on this issue. Some children expressed the idea that the conservation of rainforests is not important.

The results of this study suggest that certain ideas predominate in the thinking of children about rainforests. Pupils' responses indicate some misconceptions in the basic scientific knowledge of rainforests' ecosystems such as their ideas about rainforests as habitats for animals, plants and humans and the relationship between climatic change and destruction of rainforests.

Pupils did not volunteer ideas that suggested that they appreciated the complexity of causes of rainforest destruction. In other words, they gave no indication of an appreciation of either the range of ways in which rainforests are important or the complex social, economic and political factors which drive the activities which are destroying the rainforests. One encouragement is that the results of similar studies about other environmental issues suggest that older children seem to acquire the ability to appreciate, value and evaluate conflicting views. Environmental education offers an arena in which these skills can be developed, which is essential for these children as future decision-makers.

Questions 1–8

Do the following statements agree with the information given in Reading Sample 7?

In boxes 1–8 on your answer sheet write:

TRUE *if the statement agrees with the information*

FALSE *if the statement contradicts the information*

NOT GIVEN *if there is no information on this*

- 1 The plight of the rainforests has largely been ignored by the media.
- 2 Children only accept opinions on rainforests that they encounter in their classrooms.
- 3 It has been suggested that children hold mistaken views about the ‘pure’ science that they study at school.
- 4 The fact that children’s ideas about science form part of a larger framework of ideas mean that it is easier to change them.
- 5 The study involved asking children a number of yes/no questions such as ‘Are there any rainforests in Africa?’
- 6 Girls are more likely than boys to hold mistaken views about the rainforests’ destruction.
- 7 The study reported here follows on from a series of studies that have looked at children’s understanding of rainforests.
- 8 A second study has been planned to investigate primary school children’s ideas about rainforests.

Questions 9–13

The box below gives a list of responses **A–P** to the questionnaire discussed in Reading sample 7.

Answer the following questions by choosing the correct responses **A–P**.

Write your answers in boxes **9–13** on your answer sheet.

- 09 What was the children’s most frequent response when asked where the rainforests were?
- 10 What was the most common response to the question about the importance of the rainforests?
- 11 What did most children give as the reason for the loss of the rainforests?
- 12 Why did most children think it important for the rainforests to be protected?
- 13 Which of the responses is cited as unexpectedly uncommon, given the amount of time spent on the issue by the newspapers and television?

- A There is a complicated combination of reasons for the loss of the rainforests.
- B The rainforests are being destroyed by the same things that are destroying the forests of Western Europe.
- C Rainforests are located near the Equator.
- D Brazil is home to the rainforests.
- E Without rainforests some animals would have nowhere to live.
- F Rainforests are important habitats for a lot of plants.
- G People are responsible for the loss of the rainforests.
- H The rainforests are a source of oxygen.
- I Rainforests are of consequence for a number of different reasons.
- J As the rainforests are destroyed, the world gets warmer.
- K Without rainforests there would not be enough oxygen in the air.
- L There are people for whom the rainforests are home.
- M Rainforests are found in Africa.
- N Rainforests are not really important to human life.
- O The destruction of the rainforests is the direct result of logging activity.
- P Humans depend on the rainforests for their continuing existence.

Question 14

Choose the correct letter A, B, C, D or E.

Write your answer in box 14 on your answer sheet.

Which of the following is the most suitable title for Reading sample Passage 7?

- A The development of a programme in environmental studies within a science curriculum
- B Children's ideas about the rainforests and the implications for course design
- C The extent to which children have been misled by the media concerning the rainforests
- D How to collect, collate and describe the ideas of secondary school children
- E The importance of the rainforests and the reasons for their destruction